UNIVERSITY OF CALGARY

Healthcare System and Scope 3 Emissions Reduction

by

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Abstract

This study's main goal is to offer Alberta's healthcare industry resources on how to lower their overall environmental footprint through addressing Scope 3 emissions by expanding their Environmental, Social and Governance (ESG) strategy to foster increased engagement along the healthcare supply chain. A detailed literature analysis was undertaken to grasp the intricacy of the subject, as well as to identify current best practises in the field. The methodology also includes qualitative data collection via interviews with industry experts and from individuals from prominent facilities based in Calgary, Alberta. The conclusion of the study demonstrates the steps that healthcare institutions need to take in order to create relationships with external organisations and providers. The strategy entails recognising benefits, which aids in the alignment of their ecological aims and the reduction of their collective environmental imprint.

Keywords

Scope 3 emissions, Global Healthcare, Alberta Health Services, Supply Chain, ESG.

Disciplines

Public Policy | Sustainable Energy Development

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Finally, I thank God for giving me the strength to keep going every day for ‘What He Cannot Do, Does Not Exist!’

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List of Acronyms

AHS	Alberta Health Services
BEIS	Business, Energy, and Industrial Strategy
CDP	Carbon Disclosure Project
CH4	Methane
CI	Carbon Intensity
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalent
CSR	Corporate Social Responsibility
ESG	Environmental Social Governance
GHG	GreenHouse Gas
GHSC	Green Hospital Score Card
GLEC	Global Logistics Emissions Council
GWPs	Global Warming Potentials
IMO	International Maritime Organization
NHS	National Health Service
NOx	Nitrogen Oxides
O3	Ozone
PwC	PricewaterhouseCoopers
RFPs	Request for Proposals
RFI	Request for Information
RGH	Rockyview General Hospital

SDG	Sustainable Development Goal
SFC	Smart Freight Centre
SOx	Sulfur Oxides
UK	United Kingdom
UN	United Nations
US	United States
WHO	World Health Organization

Chapter 1 : Introduction

In order to effectively reduce Scope 3 emissions, we need to understand and measure where they are sourced from in the first place. Scope 3 emissions are GreenHouse Gas (GHG) emissions that are not generated directly by an organisation or as a result of activities that involve owned assets by the organization. Thus, Scope 3 emissions result from those activities for which the company is indirectly responsible across its value chain (National Grid, 2023a). As defined by the Commonwealth Fund (2022), healthcare Scope 3 emissions are indirect emissions resulting from the production and delivery of pharmaceuticals equipment, as well as other medical devices and services purchased by the health sector. These are also known as value chain emissions that include supply chain activities, waste management, and transportation.

Alberta Health Services (AHS) is an integral part of local and global healthcare, and in an effort to combat climate change must address the environmental impact of providing care to the population, which includes reducing its Scope 3 emissions. How can the Alberta health sector effectively involve its value chain suppliers in the goal of scope 3 emissions reductions? In accordance with the AHS initiative to reduce its carbon footprint through procurement processes, as stated in the AHS policy (2020), my research aims to provide strategies on how to best achieve this AHS sustainability target. The literature review aims to explore existing research and initiatives focused on Scope 3 emissions reduction in the healthcare sector. A detailed literature analysis has been undertaken to grasp the intricacy of the subject, as well as to identify current best practises in the field. This will include an evaluation of comparative reporting tools, GHG accounting methodologies, and current reporting trends as well as best practises for public sustainability reporting.

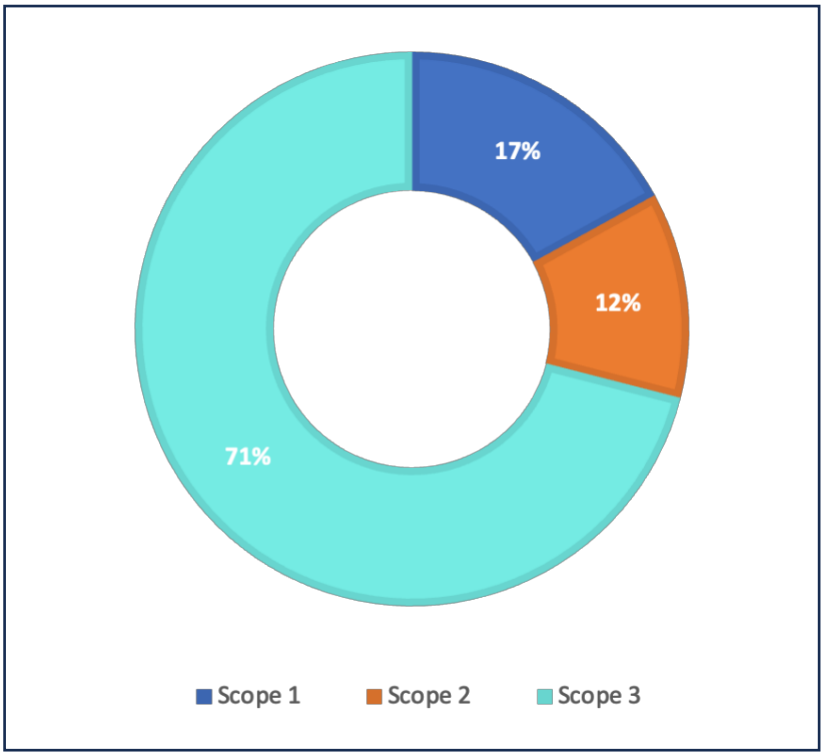
An international NGO called Healthcare Without Harm came to the most unsettling conclusion in one of the most thorough studies ever published on the impact of health systems on climate change, stating that "If global healthcare were a country, it would be the fifth-largest GHG emitter in the world" (Noharm and ARUP, 2019). Research has shown that the healthcare industry is one of the significant contributors to global GHG emissions (Li et al, 2022; Watts et al, 2019; Noharm and ARUP, 2019). It has become ironic that the healthcare industry charged with the primary purpose of saving human lives is contributing immensely to GHG emissions that are destroying the environment, and consequently harming human lives. Specifically, Canada’s health sector ranks

as one of the worst GHG emitters, when compared with other high-income countries (Eckelman et al, 2018a).

According to Brightest (2023), a company's indirect Scope 3 value chain emissions are 5 to 25 times more than its direct Scope 1 and 2 emissions, making Scope 3 emissions reduction a top priority for businesses looking to cut back on GHG emissions, lessen their environmental impact, protect their brand, and enhance ESG performance.

The emergence of GHG emissions reports has led to increased research focus on the environmental dimension of ESG. The "E" in ESG stands for environment, indicating activities aimed at reducing carbon dioxide emissions, energy consumption, and promoting sustainable development within organizations (Zeng et al, 2022). ESG performance evaluation has evolved into a standard for analysing a company's environmental and social responsibility. Credit risk and supplier ratings are frequently used to assess operational performance and financial risk when choosing suppliers (Sardanelli et al, 2022). However, traditional credit ratings primarily focus on short-term indicators and past performance, lacking consideration for a company's environmental impact. To enhance the comprehensiveness of supply chain performance evaluation, it is important to construct a model that includes environmental impact data. ESG can be incorporated into the evaluation to address the lack of non-financial indicators in conventional credit rating systems, such as environmental effect, and to motivate all participants in the supply chain to actively contribute to sustainable development and carbon emission reduction. Therefore, it is necessary to integrate ESG into green supply chain performance evaluation.

Figure 1. *Global emissions distribution from health care facilities*



Note. Noharm and ARUP, 2019.

Corporate ESG practises have extended to encompass the development and implementation of supply chain management strategies as companies become more conscious of the environmental consequences beyond their direct operations. The increasing demand for transparency and accountability for environmental performance by corporate, societal, and regulatory stakeholders have resulted in a greater emphasis on supply chain performance (Acquaye et al., 2014).

1.1 Interdisciplinary Aspect

This study is focused on two aspects of sustainability: energy and the environment, as well as a third aspect of public health sustainability. This study hopes to achieve the Sustainable Development Goals (SDG) 3 for good health and well-being, as well as SDG 13 (UNDP, 2022), which calls for immediate action to address climate change and its effects, by incorporating climate change measures into national policies, strategies, and planning. The United Nations (UN) is committed to significantly lowering the mortality and disease rate resulting from harmful

substances, air, water, and land pollutions in order to achieve good health and welfare for all by 2030 (UNDP, 2022).

1.1.1 Environment

This study assesses the GHG emissions associated with some of Scope 3 categories in the global health industry, such as energy consumption, waste generation and disposal, transportation, and procurement. This study also looks at the Scope 3 emissions profile components of the health industry that have the most detrimental environmental effects. The study also examines environmentally-conscious supply chain practices, such as selecting suppliers with low carbon footprints or employing eco-friendly products and materials.

1.1.2 Energy

Understanding and addressing the energy-related components of healthcare activities, as well as making plans to improve sustainable procurement, are some of the goals of this research on Scope 3 emissions reduction in the health sector. Organisations in the health sector can be influenced in their efforts to transition into a more sustainable procurement and supply chain management by using information gathered from this research on Scope 3 emissions reduction in the health industry that addresses the energy sustainability dimension.

1.1.3 Public Health Sustainability

The goals of this research are to understand and address the impacts of Scope 3 emissions on human health and to develop strategies to reduce them in order to protect and promote public health. This study can help the sector with information on how best to safeguard the public's health, meet emissions reduction targets, and ensure the wellbeing of healthcare workers and the local community.

Chapter 2 : Methodology

2.1 Literature Review

A literature review was done to establish historical references and investigate current procedures for Scope 3 emissions reporting. This review utilized the databases and journals included in the University of Calgary Online Library, journals and articles found in Science Direct, PubMed, and Google Scholar. The context of this review is confined to publications mostly published within the last five years, from 2018 to 2023, using the following key words: "Healthcare," "Scope 3 emissions," "supply chain emissions," "CSR strategy," and "supply chain". With the exception of a few unique cases and studies that provide more thorough background and historical information, the bulk of papers published prior to 2018 are not be included in the study. The papers that are included in this research are those that most closely embody its objectives and purposes given the time and scope restrictions.

2.2 Interviews with Industry Experts

Interviews were conducted with industry experts and analysts to better understand current practises and the problems that AHS is facing when expanding their ESG plan to include increased supply chain engagement, monitoring and reducing its environmental impacts. This qualitative data was gathered through a virtual interview. Interviewees were picked based on recommendations, job description, and their organisational role. Qualitative template analysis and coding were used to analyse the interviews. A qualitative template analysis is an analysis technique that identifies and categorises themes or patterns in data that is written like interview transcripts (Nowell et al, 2017). Coding is a critical component of template analysis, in which data is methodically organised into codes or categories to aid in the identification of repeating themes and concepts. This was conducted by:

1. By gathering data from interview and ensuring that the data is transcribed accurately and is ready for analysis.
2. Gaining a general understanding of the data and identify potential initial codes or themes by reading the data explicitly in order to become more accustomed with the information contained in it.

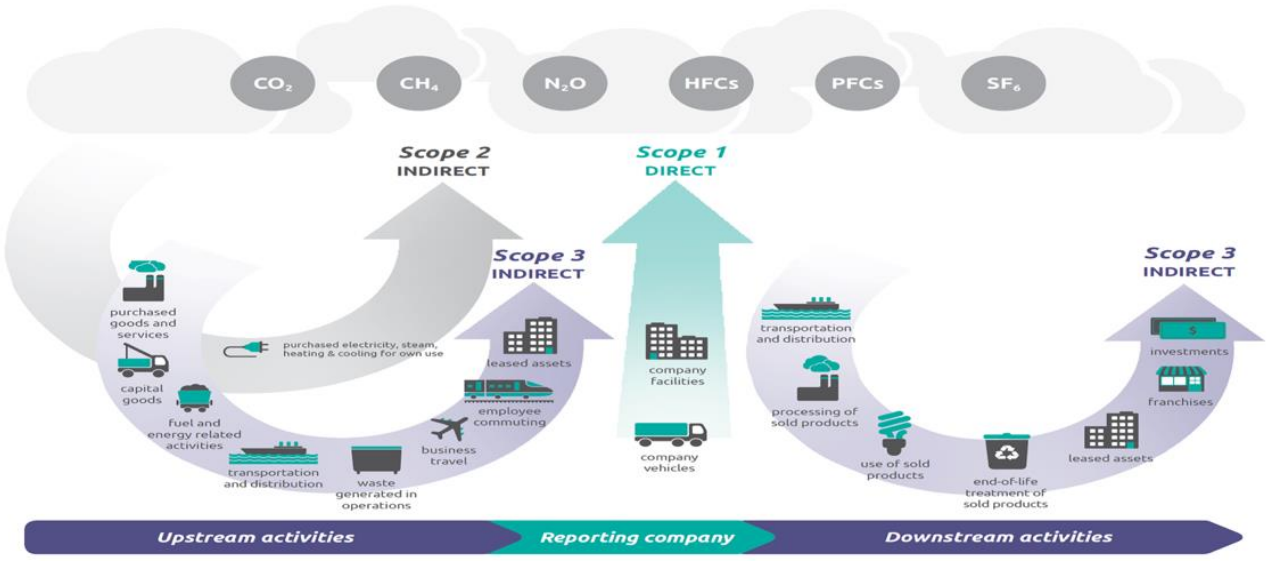
3. The next step was to commence the coding process by identifying initial (a priori) codes or labels that represent specific concepts, ideas, or themes in the data.
4. Codes were utilized to tag the appropriate sections of the data. Subsequently, the coded data was examined to detect patterns or linkages among the codes. Related codes were consolidated to establish initial categories or themes. Each transcript was reviewed by two independent reviewers.
5. After refining and finalizing the codes by comparing and contrasting the data, a coherent and comprehensive coding template was created. This template was then applied to the entire dataset, systematically coding all the data based on established categories and themes. Once the coding was complete, we conducted data synthesis to analyze the broader patterns and insights that emerge from the coded data. Major themes, sub-themes, and interesting patterns are identified during this stage.
6. The next step was data interpretation and reporting. The findings are interpreted based on the coded data, and explanations and insights are provided into the research questions or objectives. A detailed report or narrative was created to present the findings in a coherent and organized manner.

Chapter 3 : Literature Review

3.1 What are GreenHouse Gases

GreenHouse Gases (GHG) are gases present in the Earth's atmosphere that trap heat, similar to the way glass walls in a greenhouse function (Bhattrai, 2023). Without the greenhouse effect, temperatures would drastically decrease, making it too cold to sustain life on Earth (National Grid, 2023b). These gases, together with other elements, play a part in the atmospheric modifications that lead to climate change. Human activity and natural occurrences can both affect climate change. The considerable rise in GHG in the earth's atmosphere over the past decades has mostly been caused by human activity (EPA, 2023).

Figure 2. Overview of Scopes and Emissions across the Value Chain



Note. GHG Protocol (2011).

Figure 2 above graphically depicts the emissions related to an organization's operations, including logistics and people- and cargo-moving. The Scope 1, 2, and 3 categories also indicate the various sources of emissions produced during an organization's operations. The primary GHG include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and fluorinated gases (EPA, 2023a). For a better understanding of these GHG, the National Grid (2023b) have listed the following facts;

1. Volcanic eruptive, plant respiration, animal and human respiration, and other natural processes all release carbon dioxide (CO2). As research has shown, CO2 is the primary cause of climate change due to the high concentration it has in the atmosphere. There has been a 50% increase in atmospheric CO2 since the start of industrialization as a result of human activities which includes the combustion of fossil fuels and extensive deforestation.
2. Methane (CH4) is a by-product of natural breakdown. Like the CO2, human activity has increased methane concentrations in the atmosphere. Cattle rearing, the degradation of organic waste in municipal solid waste landfills, rice farming, and the conventional production and transportation of oil and gas all produce significant volumes of methane.
3. Nitrous oxide is produced through the extensive use of commercial and organic fertilisers, the combustion of fossil fuels, the creation of nitric acid, biomass burning, and wastewater treatment.
4. Fluorinated gases are man-made and extremely damaging GHG that are produced through a variety of home, commercial, and industrial applications and procedures. These gases include hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, and nitrogen trifluoride. Fluorinated gases— specifically hydrofluorocarbons—are used as sometimes as ozone-depleting alternatives. They are known to have significant Global Warming Potentials (GWPs) that range from thousands to tens of thousands compared to CO2, despite being released in smaller amounts than other GHG (European Parliament, 2023). This property, known as high-GWP gases, suggests they are capable of absorbing much more heat than CO2 for the same mass (EPA, 2023b).

Each GHG influences climate change differently depending on its atmospheric concentration, the duration, its effects on the atmosphere.

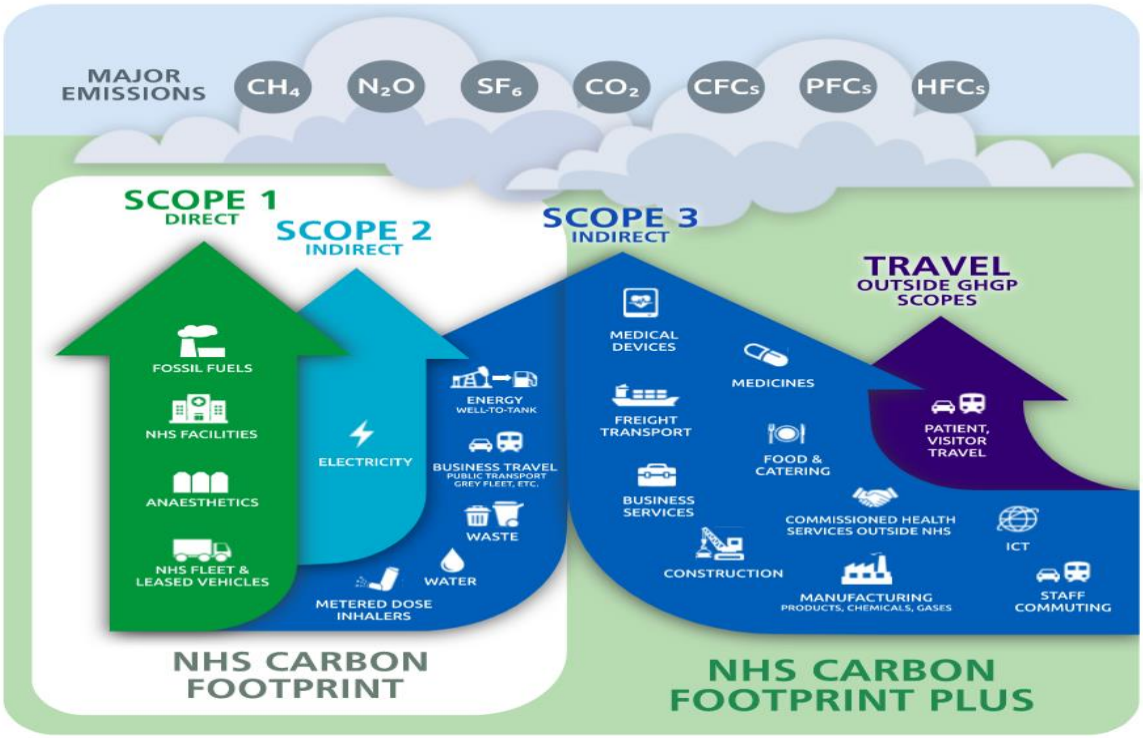
3.2 Global Healthcare Carbon Footprint

One of the service sectors with the highest carbon intensity is the healthcare sector (Elevance Health, 2022). On average, healthcare systems contribute more than 4% of global CO2 emissions and a significant amount of toxic air pollutants, mainly from fossil fuel combustion. This amount is around 10% in many developed countries, surpassing emissions from the aviation or shipping industries. (World Economic Forum, 2022; Noharm & ARUP, 2019). Among nations, the healthcare system in the United States (US) has the highest GHG emissions, surpassing any other

country's healthcare system (Pichler et al., 2019). The health damages resulting from healthcare-related pollution in the US are comparable to preventable medical errors (Eckelman & Sherman, 2016; 2018b). Similarly, Canada is among the top four countries with significant healthcare emissions per capita (Noharm and ARUP, 2019). See appendix A for Global Per Capita CO2 Emissions. According to Cummings (2019), Sherman, an associate professor at the Yale School of Medicine, estimates that the combined healthcare sectors of the US, Australia, Canada, and England emit approximately 748 million metric tons of GHG annually, which is higher than the emissions of all but six nations worldwide.

Sherman points out that while the healthcare industry is charged with the responsibility of addressing the negative effects of pollution and climate change on public health, it also makes a sizable contribution to harmful pollutants, such as GHG. Healthcare institutions and their value chains can be said to be responsible for these emissions. To protect the public health from healthcare pollution, the concept of patient safety should be expanded to encompass the indirect health harms brought on by these emissions (Sherman et al., 2020; Sherman et al., 2019; Eckelman & Sherman, 2016). The financial costs associated with the disease burden caused by healthcare emissions have not been fully calculated, but they should include expenses related to increased demand for healthcare services and the need for relief and recovery from climate-related disasters. When transitioning to a clean energy economy, higher healthcare emissions can be considered tolerable if it means the transitioning will lead to improved health outcomes. Compared to other high-income countries, the United States spends more on healthcare, yet it does not provide benefits that are as good as those provided by these other countries (Tikkanen & Abrams, 2020).

Figure 3. Overview of Scopes and Emissions in the Healthcare sector



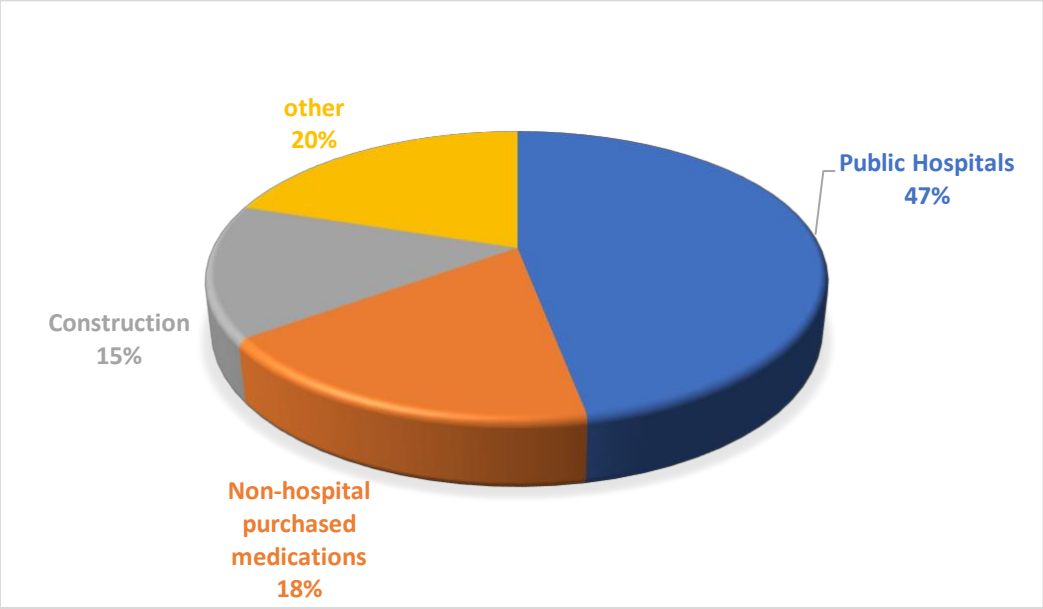
Note: NHS (2023).

International efforts to quantify and mitigate GHG emissions in the healthcare sector are growing, with a particular emphasis on accountability (Eckelman et al, 2020). To determine the total GHG emissions in healthcare, three categories need to be considered: emissions generated directly from healthcare facilities (referred to as Scope 1), emissions indirectly produced through purchased electricity (Scope 2), and emissions occurring in the supply chain during the production of goods and services procured by healthcare systems (Scope 3). According to Eckelman et al, (2020), analysing the overall emissions of healthcare involves adopting either expenditure-wide or facility-level accounting approach. While expenditure-based methods provide a comprehensive assessment by accounting for all emissions throughout the supply chain, the results are generalized and not specific to individual facilities. This method is frequently employed to calculate the nation's total GHG emissions from the healthcare industry (Noharm, 2019; Eckelman et al, 2018; Sherman et al, 2020; Tikkanen and Abrams, 2020). However, in order to compare healthcare organisations and execute institution-specific interventions, it is crucial to take emissions at the

facility level into account (Sherman et al, 2020). Unfortunately, it is extremely difficult to obtain facility-level data, especially when reporting is not required (Eckelman et al, 2020).

Looking at the healthcare emissions in China, Wu (2019) found that in 2012, China spent CNY 2539 billion on health care, resulting in emissions of 315 (68% Carbon Intensity [CI] 267-363) (MtCO2e). This is equivalent to 2.7% (68% CI 2.3-3.1) of country's GHG emissions.

Figure 4. Proportion of total Healthcare system GHG emissions



Note: Wu, (2019)

Only 16% of the carbon footprint in medical facilities was caused by energy use for buildings and transportation; the other 84% was caused by the goods and services that were acquired. This was determined by applying the environmentally extended input-output analysis to measure the carbon footprint (total CO2e emissions) of the Chinese health-care system (Wu, 2019).

There are more media articles than existing research studies in academia on the global carbon footprint of the healthcare sector. According to Scannell (2022), 8.5% of all US GHG emissions are produced by the healthcare industry, with the sector's supply chain being the main source. He also stated that, notwithstanding it's comparison to medical mistakes, the healthcare pollution in the U.S. has not received the same level of attention. In a similar vein, Public Health England and the National Health Service (NHS) determined that England's health and social care carbon footprint was 27.1 Mt CO2e in 2017, representing approximately 6.3% of the country's

climate footprint (WHO, 2015). A 2019 report by Health Care Without Harm (Noharm) and ARUP provided a detailed estimate of the global climate footprint of the healthcare sector, identifying emissions sources and offering suggestions for coordinating climate and health goals. Another research article by Teuton et al. (2017) highlighted the purchase of pharmaceuticals and medical devices as the major sources of Scope 3 emissions in the Scottish health sector. This study aimed to increase public awareness of healthcare-related Scope 3 emissions. The National Health Service (NHS) of England has made a commitment to achieve a net-zero national healthcare system by 2040 as a result of these results, making it the first organisation of its sort to do so globally (NHS, 2023). Scope 1 and 2 emissions are easier to account for than Scope 3 emissions. An observation based on my research is that there isn't enough research done in academia on Scope 3 emissions in the global healthcare sector.

3.3 Canada's Healthcare Carbon Footprint

Among developed countries, most environmental-related deaths and disabilities are linked to cardiovascular disease, respiratory illnesses, and cancer - all of which are associated with air pollution. Air pollution, which is a major environmental factor in mortality, is responsible for one out of every eight fatalities worldwide (WHO, 2015; Cohen et al., 2017). Air pollution is also thought to be the sole cause of more than 20,000 premature deaths in Canada annually (WHO, 2015; Cohen et al., 2017). Furthermore, due to changing trends in infectious diseases, shortage of food and water, and severe weather conditions, climate change has continued to pose an increasing risk to world health. According to projections made by the WHO and Watt et al. (2017), between 2030 and 2050, climate change will contribute an additional 250,000 deaths per year, making it a significant public health risk for the twenty-first century. Ironically, the health of people is badly impacted by the pollution that the healthcare industry itself emits.

Additionally, the manufacturing and disposal of pharmaceuticals and biohazardous products contribute to environmental hazards (Umwelt, 2017; WHO, 2012). Canada is responsible for approximately 1.6% of global GHG (GHG) emissions, making it the 10th largest emitter and one of the highest per capita emitters in the world (Environment and Climate Change Canada, 2023; Climate Watch, 2023). The Canadian health care sector accounts for 4.6% of all emissions that come from the country (Eckelman et al., 2018a). Canada's healthcare system produces 33 MtCO2e and over 200,000 tonnes of other pollutants, with emissions from hospitals and pharmaceuticals

being significant contributors (Eckelman et al., 2018a). Canada ranks third among 47 nations in terms of healthcare system emissions per capita (CMA, 2019). Given Canada's considerable GHG emissions, the healthcare industry has a significant role to play in achieving Canada's emissions reduction goal. The health sector's supply chain together with the service model emissions account for 5% of Canada's overall GHG emissions and causes the loss of 23,000 disability-adjusted life years annually (Tseng, 2020). To establish an effective emissions reduction framework, Canada's healthcare sector can draw inspiration from the National Health Service (NHS) of the United Kingdom.

The 2019 Green Hospital Score Card (2021) outlines the estimated sources of GHG (GHG) emissions in Canada's healthcare sector, categorized into three scopes of GHG analysis:

Scope 1 (26%):

- On-site combustion: This refers to the burning of fuels inside healthcare facilities to produce power, heat, or steam. It adds to the direct emissions brought on by the hospital's own combustion procedures.
- Company-owned/controlled vehicle emissions: These are produced by the burning of fuel in cars that belong to or are under the control of a healthcare organisation.
- Nitrous oxide and anaesthetic gases: Emissions related to the use of nitrous oxide, a offshoot of some medical procedures, and anaesthetic gases, which have strong greenhouse effects.
- Fugitive emissions: These include unintentionally released emissions from things like cooling systems and fire suppression substances.

Scope 2 (13%):

- Electricity: These are emissions associated with the electricity purchased by the healthcare organization as well as the indirect emissions related to electricity transmission and distribution losses.

Scope 3 (61%):

- Waste management: These are emissions from waste management activities within the healthcare organisation. These include the supply and disposal of water and solid waste.
- Transportation: This category includes emissions from employee travel for work-related activities as well as employee commutes to and from work. Emissions from patient transportation to medical facilities are also considered.

- Supply Chain:
  i. Pharmaceutical emissions are those produced during the manufacturing, distribution, and disposal of pharmaceuticals used in the healthcare industry.
  ii. Medical device emissions are those from the production, transportation, as well as from the disposal of medical devices during their lifecycle.
  iii. Food emissions originate from the production, transportation, and disposal of food used in medical facilities.
  iv. Construction emissions are from construction activities that include (among others) the delivery of supplies used in the construction of healthcare facilities.
  v. Other-general: These are missions related to other components of the healthcare industry's supply chain that are not addressed in the categories above.

3.4 Scope 3 Emissions in the Healthcare Sector

As organizations across sectors continue to map their Scope 1 and Scope 2 emissions, there is a growing focus on Scope 3 emissions and the methodologies for accounting them. On average, approximately 74% of a company's overall carbon footprint comes from its upstream Scope 3 emissions (King, 2017). According to Boston Consulting Group, less than one in ten organisations are accurately tracking their GHG emissions, exposing a significant roadblock on the way to net-zero (Shepherd, 2021). As stated in a report issued by the business planning consultancy of Bloomberg, only 9% of businesses have the capacity to precisely and routinely monitor their emissions. According to the study, 81% of businesses fail to report emissions resulting from their own operations, while 66% fail to include emissions from their suppliers and clients. More than half of businesses admitted to having an error rate as high as 40% (Shepherd, 2021). Scope 3 emissions encompass sources that are outside the organization's direct control, unlike Scope 1 and Scope 2 emissions. For one organization, the Scope 3 emissions correspond to the Scope 1 and Scope 2 emissions of another organization. These value chain emissions, also known as Scope 3 emissions, often constitute the majority of an organization's total GHG emissions (EPA, 2023b). According to Downie and Stubbs (2013), the absence of Scope 3 reporting can be attributed to the lack of clear guidance on identifying relevant emission-generating activities. Furthermore, the research contends that US organisations are discouraged from identifying Scope 3 operations, calculating associated emissions, and disclosing them publicly due to the significant costs related

to time, labour, and regulatory compliance or risk mitigation (Downie and Stubbs, 2013). In comparison to Scopes 1 and 2, Scope 3 emissions can be harder to quantify because data collection can be difficult.

The World Health Organization (WHO, 2015) asserts that procurement activities, including waste management, transportation, and staff commuting, are some of the notable causes of these emissions. Similarly, Noharm (2019) indicates that 71% of Scope 3 emissions in healthcare primarily arise from the sector's supply chain, including the production, transportation, use, and disposal of goods and services consumed by the sector.

3.5 Drivers of Scope 3 Emissions in the Healthcare Sector

Scope 3 Emissions in the Healthcare can be ascribed to a variety of sources, which can be categorized into several important areas.

3.5.1 Supply Chain Emissions

One significant contributor to Scope 3 emissions is the healthcare supply chain. For medical equipment, medications, and other products and services, the healthcare sector depends on a broad network of suppliers and vendors. Supply chain emissions also contribute significantly to pollutants that have an impact on the environment. Understanding and addressing the environmental consequences linked to the healthcare supply chain are crucial for successfully reducing Scope 3 emissions. Various stages involved in the procurement and lifecycle of medical equipment, pharmaceuticals, consumables, and other goods in the healthcare sector contribute to Scope 3 emissions (WHO, 2015).

Logistics also play a significant role in contributing to Scope 3 emissions in the healthcare industry, along with other platforms such as raw material extraction, manufacturing, packaging, and disposal. These emissions are exacerbated by the movement of commodities along the healthcare supply chain, including delivery to hospitals, pharmacies, and distribution centres. This covers the fuel consumption and emissions from vehicles such as trucks and airplanes. For example, the National Health Service (NHS, n.d.) procures goods from a vast network of over 80,000 vendors, including those supplying food, office supplies, and medical equipment and about 42% of the GHG emissions from the NHS are caused by these non-medical supply chain activities. Although the

NHS may not have direct control over these emissions, its enormous purchasing power enables it to have significant leverage over its suppliers to affect change. By 2030, NHS's goal is to decrease emissions in the supply chain through improved resource utilization, adopting low-carbon alternatives, promoting product innovation, and ensuring that suppliers are implementing measures to reduce carbon emissions in their own operations. See appendix B for NHS Emissions Reductions Past and Projected.

3.5.2 Waste Management

The waste from healthcare facilities are made up of a substantial amount of hazardous and non-hazardous waste in addition to medical waste. Waste treatment and transportation contribute to Scope 3 emissions due to energy use and emissions from landfilling or waste incineration. Sustainable waste management requires that waste is managed in a way that is socially acceptable and financially and environmentally sound. Adopting the 3Rs hierarchy—Reduce, Reuse, and Recycle—is the first step in managing waste sustainably (Joint Position Statement, 2009).

According to data from Statistics Canada (2019), hospitals accounted for 1% of Canada's total solid waste in 2001. Due to the requirement of infection control practices and the need to provide high-quality care, hospitals consume a significant number of single-use products, many of which are made of plastic. While the principles of reduce, reuse, and recycle are important, the current resource usage and waste management model still leads to substantial waste disposal, as the system lacks optimization for waste reduction, reuse, and recycling. One of the most significant obstacles to healthcare waste management is the variety of waste streams, which includes both hazardous and non-hazardous waste. According to the Canadian government, the country generates about 6 million tonnes of hazardous waste annually (Government of Canada, 2019). Although Canadian hospitals are gradually shifting from on-site incineration to centralized provincial facilities for biomedical waste sterilization, there are concerns that medical waste disposal in Canada relies too heavily on voluntary compliance rather than strict regulation, indicating the need for a more comprehensive national approach (Walkinshaw, 2011). According to Kidd (2023), it is estimated that only 66 percent of healthcare facilities globally handle medical waste safely, and often it is the most vulnerable populations living near these waste sites who suffer the most.

3.5.3 Transportation

This section will provide examples and background information on air quality and GHG emissions from the movement of patients, personnel, and goods within the healthcare sector.

3.5.3.1 Road Transport

Road mobility is a substantial contributor to Scope 3 emissions in the healthcare sector. It includes transporting patients, healthcare workers, as well as medical supplies and equipment. Road mobility affects Scope 3 emissions in the health sector as has been described below:

- Patient Transportation: This includes ambulances (road and air), and other medical vehicles used for patient transportation. These vehicles release emissions because they are powered by fossil fuels in their engines. In remote areas where accessibility to medical facilities may be limited, road transport is crucial for non-emergency patient transfers and emergency response services.
- Staff Transportation: healthcare employees in most cases commonly use their own vehicles or public transportation to go to work and back home. The frequency of travel and the means of transportation both have an impact on GHG emissions. Promoting alternate modes of transport, such as carpooling, public transport, or cycling, can assist in lowering the emissions produced by employee commutes.
- Road transport is utilised in the logistics portion of the supply chain to carry equipment, drugs, and medical supplies to healthcare facilities. Emissions from suppliers' cars and delivery trucks are produced during the transit process. Reducing emissions from this aspect can be achieved by putting into practise effective supply chain management techniques, such as optimising delivery routes and using low-emission vehicles (SCS, 2023).
- Homecare services: Homecare professionals frequently drive their own automobiles to patients' homes. The Scope 3 emissions in the healthcare sector are increased by these vehicles. Emissions can be reduced by looking into alternate transportation options for home healthcare services, such as electric or hybrid vehicles.

The transportation business contributes significantly to GHG emissions, which are mostly due to the use of fossil fuels in vehicles, ships, trains, and airplanes. Around 94% of transportation fuel is produced from petroleum-based sources (EPA, 2023b). In 2021, transport was identified as the

second-largest source of GHG emissions in Canada, accounting for 22% of total emissions with 150 million tonnes of carbon dioxide equivalent (Mt CO2 eq) emitted (Government of Canada, 2023). This implies a 4.8% increase from the 2020 figure of 143 Mt CO2e. (Government of Canada, 2023). The same analysis states that between 1990 and 2021, GHG emissions from Canada's transport industry climbed by 27%. The increase in emissions was mostly caused by the growing use of passenger light trucks and heavy-duty trucks for freight. These emissions are as a result of fuel combustion and the operation of these vehicles.

3.5.3.2 Shipping Industry

Scope 3 emissions linked with shipping in the healthcare sector typically involve the transportation of medications, medical supplies, equipment, and other healthcare-related products. The burning of heavy fuel oil or the use of fossil fuels in ship engines are the main reasons why the shipping industry makes a considerable contribution to GHG emissions. CO2 constitutes a large amount of these emissions, with small amounts of other pollutants such sulphur oxides (SOx), nitrogen oxides (NOx), and particulate matter (Merk, 2014).

There are several different shipping modalities used to convey healthcare goods, including land-based, air-based, and maritime. Due to the substantial number of commodities transported by sea on a global scale, maritime transport in particular contributes significantly to Scope 3 emissions in the healthcare industry. These emissions are produced because of the lengthy distances travelled and the energy-intensive nature of marine business.

The International Maritime Organization (IMO) has implemented regulations to decrease sulphur emissions in the shipping industry. One notable regulation is the IMO 2020 rule, which aims to limit the sulphur content in marine fuels. According to an IMO (2022) research, ships are mandatorily required to use fuel oil with a sulphur level of no more than 0.5% beginning January 1, 2020. This is a significant reduction from the previous maximum of 3.5%.

The purpose of this rule is to reduce the negative health and environmental effects of sulphur oxide (SOx) emissions from ships. SOx emissions are one of the sources of air pollution and they are linked to problems with the cardiovascular system and respiration issues. By lowering the sulphur content of marine fuels, the IMO aims to enhance air quality and lessen the harmful health effects caused by industry emissions.

3.6 Sustainability in the health care system

The methodological knowledge necessary to measure the environmental impact of healthcare has seen significantly growth in recent years. The carbon footprint of numerous healthcare components, such as hospitals, anaesthetic gases, medical devices, and consumables, has recently been the subject of much investigation. Lenzen et al. (2020) conducted a recent study that provided a thorough evaluation of the healthcare industry's environmental impact on the planet by evaluating its contribution to the global GHG emissions, particulate matter, NOx and SOx emissions, malaria risk, nitrogen pollution, and water usage. A healthcare sustainability metric must perform tasks similar to those needed for healthcare quality measures in order to be effective, by directing the selection of appropriate technical approaches to measurement based on its purpose rather than being influenced by measurement practicality, and ensuring a balanced consideration of various environmental impacts rather than disproportionately focusing on readily measurable GHG emissions (Henser & McGain, 2020).

Internationally, there are several approaches to environmental sustainability reporting in the health sector that reflect distinctions in health systems and the supposed purpose of reporting. The aforementioned approaches include:

3.6.1 Climate Risk Disclosure

A large number of healthcare providers, insurers, pharmaceutical firms, medical device producers, and supply companies already take part in voluntary disclosure initiatives, like the Carbon Disclosure Project (CDP), which highlight organisations' susceptibility to climate change risks. By utilising established methods such as the Science-Based Target Initiative (SBTi) or the CDP, the NHS has the opportunity to increase transparency among digital suppliers. International institutions are recommending systematic disclosure of climate risk governance, strategies, risk mitigation actions, measurements, and targets for organisations across all sectors (GFSR, 2009).

3.6.2 Corporate Social Responsibility Reporting

According to Senay and Landrigan (2018), the healthcare sector in the US has a slower rate of sustainability reporting compared to other sectors. Some large organizations in the health sector include sustainability reporting in their corporate social responsibility reports or activities. However, generally, there are fewer healthcare companies who are publishing

their sustainability statistics. According to Senay and Landrigan (2018), these findings have been explained by a number of variables, including the absence of shareholder pressure and a perceived moral counterbalance brought on by the healing purpose of healthcare organisations. However, a rising number of US hospitals have taken part in initiatives to increase sustainability reporting sustainability

3.6.3 Publicly Required Reporting

Public reporting is a method of quality improvement that involves sharing quality-related information with the broader public. This data is based on systematically obtained comparative data and pertains to identifiable professions and providers, such as individuals and institutions (Cacace et al, 2019). The purpose of public reporting is to improve healthcare effectiveness, safety, and/or responsiveness through two channels. The first approach (selection pathway) entails empowering patients to select high-quality providers and experts based on the reported indicators. The second method- change pathway, entails incentivizing providers and experts to improve the quality of care they give (Cacace et al, 2019). The NHS England Sustainable Health Dashboard is one of the most comprehensive methods to healthcare environmental sustainability reporting anywhere in the world. According to Henser & McGain (2020), this dashboard offers performance information on a variety of indicators in the areas of governance, carbon, resources, water, and waste, air pollution, plastics, and adaptation for each NHS provider, clinical commissioning group, and region in England. It delivers performance statistics across multiple dimensions for NHS providers, clinical commissioning groups, and regions in England. Unified accountability and financing procedures promote mandated data collection and reporting (Henser & McGain, 2020). As part of the state government funding policy in Victoria, Australia, public health providers are mandated to disclose standardised environmental impact measures (Victoria State Government, 2020). These indicators include energy consumption, GHG emissions, water consumption, and garbage generation. The experiences of the United Kingdom and Australia are significant, as there have been proposals in the US to incorporate sustainability indicators into Medicare's Quality Payment Programme (Sherman and Lagasse, 2018).

3.6.4 Organisational Level and Reporting Units

The goals of performance reporting determine the measurement and reporting methodologies chosen. Healthcare environmental reporting, like healthcare quality reporting, necessitates diverse methodologies across different levels, such as healthcare systems, personal services, units, or doctors. Internal benchmarking reports and performance league tables can be prepared at the level of an entire health service, whereas public accountability, pay-for-performance, and corporate social responsibility reporting are typically generated at the organisational level. The breadth and degree of reporting should be consistent with a clear plan, taking into account the best as approach.

3.7 Why the Healthcare Sector should Report Emissions

The healthcare sector reports emissions for several reasons, including:

1. Environmental Responsibility: Healthcare organisations are aware of their obligation to reduce their environmental impacts and support sustainable practises. Healthcare facilities are aware of how their operations and resource usage, as organisations committed to improving health and wellbeing, contribute to environmental deterioration. Healthcare organisations show transparency and accountability on their environmental impacts by reporting their emissions. It enables them to evaluate their carbon footprint, pinpoint areas for improvement, and puts emission-reduction plans into action. Taking ownership of their environmental impact reflects a dedication to fostering a healthier planet for both present and future generations, which is consistent with sustainability principles. In addition, by reporting emissions, the sector can encourage the need to prioritise environmental sustainability and implementation of sustainable practises.
2. Regulatory Compliance: In order to comply with legal obligations, the public health sector of the state of Victoria for example is mandated by the government to disclose its emissions (Victoria State Government, 2023). Specific rules and regulations pertaining to GHG emissions and environmental effects may be established by governments and regulatory agencies. These laws frequently apply to healthcare facilities, and in order to comply, they must track and report their emissions. For hospitals to be eligible for Medicaid and Medicare reimbursement in the US, accurate reports of GHG must be submitted. This mandate is in line with the conditions of participation in the US, as the harmful health consequences associated with these emissions can be seen as a form of medical error (Introcaso & Vernon, 2021). The objective of healthcare facilities in lowering their GHG emissions is to enhance health outcomes. Healthcare organisations

show their dedication to environmental responsibility and compliance to legal requirements by disclosing their emissions. This aids in upholding their legal standing and avoiding fines or sanctions for breaking the law. Compliance with regulations also promotes transparency and accountability, enabling stakeholders and the general public to evaluate how well healthcare facilities protect the environment. To comply with the O.Reg. 25/23 Electricity Act, 1998- Broader Public Sector, entities in the Municipalities, Universities, Schools and Hospitals (MUSH) sector are expected to submit annual reports documenting their energy usage and GHG emissions (LHSC, n.d.). They must also develop and disclose a five-year conservation and demand management plans (LHSC, n.d.).

3. Public Health and Safety: The healthcare sector has the responsibility to report emissions for the sake of public safety and health. Public health and safety are adversely affected by emissions from healthcare-related activities, therefore, reporting emissions stimulates the deployment of measures to mitigate and aids in the identification of potential health concerns linked to specific activities. This is consistent with the larger goal of promoting environmentally friendly healthcare practises and ensuring community wellbeing. Molero et al. (2021), emphasise that the significance of sustainability measures in the healthcare sector and the necessity for emissions reporting to tackle public health concerns, is one source that demonstrates the significance of emissions reporting for public health and safety. It highlights the fact that lowering emissions can lead to better air quality, reduced exposure to dangerous contaminants, and improved general public health outcomes.

4. Expectations of Stakeholders: Investors, patients, employees, and communities have increased their expectations of organisations to address environmental concerns and exhibit responsible behaviour towards the environment. Emissions reporting promotes transparency and aids in the development of stakeholder confidence. Furthermore, by disclosing their emissions, healthcare organisations can meet the demands of stakeholders while also enhancing their reputation as environmentally concerned and socially responsible organisations. Organisations must be ready to respond to difficulties, both anticipated and unanticipated, in order to develop and retain Stakeholders' confidence towards their climate efforts (Weirens et al, 2021).

5. Benchmarking and Performance Comparison: The major goal of benchmarking the sector is to develop industry standards for reporting sustainability and logistics, which will then be used to determine where each health organisation stands in comparison to peer organisations and leaders

in the field of sustainability (King, 2017). Reporting emissions allows healthcare organisations to compare their performance to that of their peers in the industry and discover areas for improvement. It serves as a foundation for setting goals, tracking progress, and exchanging best practises throughout the industry. Studies have emphasised the need of benchmarking and performance comparison in the healthcare sector. Benchmarking is critical for identifying pollution hotspots and influencing sectors and organizations to take action to decrease them. Standardised emission reporting and benchmarking technologies are required to enable reliable performance comparisons across healthcare facilities.

6. Reduce Cost: Emission monitoring and evaluating can find inefficiencies and apply methods to reduce energy usage and waste, resulting in cost savings. Eckelman et al. (2018b) conducted a study that emphasised the potential cost savings related with emissions reduction in the healthcare industry. According to the findings of the study, adopting energy efficiency measures and adopting environmentally friendly practises could result in significant financial savings for hospitals. An example is through incentive for action that comes from the Inflation Reduction Act of the US. The Act has made credits available to non-profits, a group that includes just over half of the country's hospitals, as well as considerably expanding tax incentives for U.S. businesses that use energy-saving renewable technologies (Pennar, 2022). Healthcare facilities can acquire insights into their environmental impact and identify areas where emissions reduction strategies can be successfully employed by tracking and reporting emissions.

7. Mitigation of Climate Change: Healthcare organisations understand that decreasing emissions adds to worldwide efforts to mitigate climate change (WHO, n. d.). To assist in reducing climate change, the healthcare sector has a responsibility to report its emissions. By identifying and reporting emissions, healthcare facilities can identify the primary sources of emissions from their regular activities and develop strategies to reduce them. This proactive strategy aids in meeting emission reduction targets and promoting environmentally friendly practises.

3.8 Challenges

Organisations have a tremendous opportunity to involve their suppliers in accelerating global decarbonization through Scope 3 emissions. For instance, actions to reduce supply chain carbon emissions put in place by a small number of end-user companies can have a significant knock-on effect by lowering emissions for several organisations along the supply chain but not without a lot of effort. There are significant challenges to reporting and reducing Scope 3 emissions. According to IBM (2022), the most cited challenges include: identifying boundaries between Scopes; obtaining credible data from a variety of vendors and locations; selecting emissions factors to generate accurate calculations; and collaboration with suppliers to disclose emissions and mitigate those emissions. An article released by PWC (2023) outlines the following challenges that organizations face in addressing and reporting Scope 3 emissions:

1. Using static third-party sources: To compute Scope 3 emissions, it is unavoidable to rely on static third-party sources such as secondary databases. Organisations require primary chain data, which is frequently unavailable, in order to successfully report advances. As a result, it is critical to build a solid and honest connection with suppliers. This collaboration not only allows for the generation of shared value, but it also provides for increased openness regarding emissions.
2. Input-output models can be used to estimate upstream emissions using a spend-based method. This is the quickest and easiest method, and aids in the identification of substantial areas of emissions. However, spend-based modelling frequently depends on industry-average emission variables, which may not adequately represent a company's individual emissions footprint. As a result, this technique may lack the amount of detail required to enable informed decision-making and identify specific opportunities for reducing carbon emissions. Furthermore, the paper notes that, according to studies, managers risk prioritising the model and its assumptions over genuine attempts to reduce Scope 3 emissions if they rely too heavily on models.
3. A widespread method for calculating Scope 3 emissions is to predict from a small sample of providers. However, if a company lacks the essential statistical skills, the data produced is unreliable.
4. Organizations frequently lack the organisational structure and methods necessary to supervise the estimation, measurement, and extrapolation of Scope 3 data across various

business units, even when they have the necessary knowledge. These techniques usually include subjective or erroneous assumptions and conclusions which are not always controlled. As a result, Scope 3 reporting will not cover the most significant and influential things, but merely those that are easiest to measure.

3.9 Health Sector Scope 3 Emission Methodology

The GHG Protocol is a comprehensive, globally recognised standard for quantifying and reporting emissions so for healthcare organisations aiming to measure and reduce GHG emissions (AHRQ, 2022). For its commitment to reduce global emissions, the NHS is regarded as a model in the healthcare industry. As a result, this section will examine the approach used by the NHS to account for and report Scope 3 emissions. The NHS adopts the Corporate Value Chain (Scope 3) Standard and the Carbon Reduction Plans guidelines by the GHG Protocol. The CDP follows the methodology of the GHG Protocol and is a widely recognized standard for corporate carbon accounting and reporting. The Corporate Value Chain (Scope 3) Accounting and Reporting Standard was developed to assist organizations in inventorying and reporting indirect emissions from their supply chain activities (GHG Protocol, 2011). This guide not only serves as a guide for Scope 3 accounting, it also supports the development of effective management strategies to reduce Scope 3 emissions. This is achieved by giving companies insight into their value chain emissions and increasing their awareness of the associated opportunities and risks. The five guiding principles of GHG accounting and reporting disclosures according to GHGP (2013) are: relevance, completeness, consistency, transparency, and accuracy. The material challenges that the organisation has identified will determine which principles can take precedence, with the objective of minimising compromises as the accuracy and completeness of reporting improves over time (King, 2017).

There are fifteen main categories of emissions from the global value chain covered by CDP reporting for Scope 3. These categories cover a wide range of areas, including waste management, the handling of solid waste at the end of their useful lives, and purchased goods and services. Although the effects of each category on an organization's emissions differ, it is important to define distinct boundaries for each category on its own. Boundary defining assists organisations in determining which categories are significant and hence require reporting, as well as in standardised

procedures for comparison over time and, ideally, across organisations. The GHG Protocol methodology provides instructions on reporting for each of the fifteen categories, together with category descriptions, examples, advice on data collection, necessary activity data, emission factors, and techniques for summarising calculations (GHG Protocol, 2013).

The goal of the GHG Protocol methodology is to offer the essential facts in a way that instructs users on how to efficiently collect and report data. The variety of calculating techniques used for the many Scope 3 categories, however, makes it clear how difficult it is to measure Scope 3 emissions. Additionally, there can be a ranking system in place that favours more precise techniques for producing Scope 3 emissions data. It is believed that the more intricate techniques frequently demand more work and time to execute. It is important to note that any health organisation that chooses to use the GHG Protocol should create a structure that balances decision-makers' needs with the accuracy of the calculation approach. This guarantees that emissions, time, and resources are efficiently allocated in accordance with the company's environmental sustainability plan and objectives.

The SmartWay Vision 2020 described by the EPA (2015), as ‘A New Era of Freight Sustainability. As a market-based project, the SmartWay programme seeks to address long-term trends and difficulties in the freight transportation industry. The programme makes use of technological solutions and commercial incentives to spread knowledge about the value that freight adds to the economy, its place in the value chain, and the possibility of enhancing transportation systems in order to meet environmental objectives. To minimise emissions on a global scale, SmartWay is extending the scope of its emissions assessment and monitoring tools to include all forms of freight transportation, including truck, train, barge, air, and marine (EPA, 2015).

The programme offers carriers and shippers assessment tools, producing accurate performance data in accordance with EPA regulations and peer-reviewed procedures. Carriers gather information on fuel consumption, driving distances, vehicle and engine models, and cargo payload, which is used to determine how environmentally friendly the freight is (EPA, 2015). The shipper reporting tool then utilises the information to compute an emissions compliance composite weighted average. The data is quality-checked by SmartWay, which also computes emission ratings and evaluates carrier performance publicly on its website. Additionally, the programme provides firms with excellent environmental performance with EPA recognition.

However, the SmartWay programme has some restrictions. It remains optional, requiring both carriers and shippers to report but not imposing emission reductions. Participants must put in a lot of work, and performance rankings throughout time are not given year by year. Additionally, the program's applicability outside of the United States and its business may be questioned because it is concentrated on the U.S. freight transportation industry. The SmartWay programme, however, acts as a model for other nations and exemplifies the potential for partnership-based programmes to address freight emissions and foster cooperation between governmental organisations and industry towards shared environmental goals (EPA, 2015).

The Smart Freight Centre (SFC) formed the Global Logistics Emissions Council (GLEC) in response to the demand for a widely accepted technique to estimate logistics emissions. In order to provide a method for calculating emissions from multifaceted supply chains, the council developed the GLEC framework. Calculating GHG (GHG) emissions requires identifying the transport chain, gathering information on the weight of the goods and the distance travelled, and utilising consumption factors unique to each method of transportation (Greene & Lewis, 2016). The outputs of the framework can be used to pinpoint problem areas in the transportation system, evaluate total emissions, and comprehend how effectively various modes, carriers, and transportation services emit GHGes.

Depending on the organization's role, different benefits can be obtained from employing the GLEC Framework. Organisations can optimise their supply chains, manage carrier performance, exhibit leadership in sustainability, and highlight their dedication to product delivery in a sustainable way by taking part as shippers or logistics service providers (Greene & Lewis, 2016). The GLEC Framework does not have different tiers for partnering or reporting, in contrast to other programmes like the SmartWay Partnership Programme (King, 2017). Participants in the GLEC Framework are anticipated to be at an advanced stage of their sustainability journey and to devote a significant amount of effort and money to creating emissions inventories and monitoring global freight volumes and distances (Greene & Lewis, 2016).

The methods outlined above can help organisations create emissions inventories, assess their impact, and identify risks and opportunities. It is also important to note that there are other ways to measure and report emissions in the healthcare industry besides the above mentioned. Due to the use of diverse approaches, comparing emission reduction objectives and progress among organisations, even those of similar size or with similar product portfolios, can be difficult and

time-consuming. Furthermore, choosing the optimal methodology for their particular activity may be challenging for organisations that are new to emissions measurement and target-setting.

Chapter 4 : Case Study

Since its inception in 2009 as a component of a comprehensive provincial health system, Alberta Health Services (AHS) has evolved dramatically. This has been accomplished by increasing access to healthcare, accelerating improvements in patient care, preventing illness and promoting health, streamlining governance and accountability, promoting standardisation through provincial programmes, improving organisational leadership and culture, combining tasks to save money, and establishing Canada's largest provincial clinical information system. The AHS 10-year plan calls for an emphasis on wellness, in addition to community-based care, to reduce the need for treatment in hospitals and other facilities.

AHS is Canada's largest integrated health system, providing services to over 4.4 million Alberta residents as well as residents from the provinces of Saskatchewan, British Columbia, and the Northwest Territories (AHS, 2023). AHS provides health care through a broad network of facilities that includes 106 acute care hospitals, psychiatric centres, long-term care facilities, and addiction and mental health spaces (AHS, 2023). The organisation comprises around 112,300 dedicated employees, as well as numerous volunteers and physicians. AHS is also critical in providing clinical instruction to students from a variety of universities and colleges. Overall, AHS is committed to providing comprehensive healthcare programmes and services that promote the well-being of Albertans (AHS, 2023).

The province of Alberta's Emissions Reduction and Energy Development Plan seeks to establish Alberta as a global leader in emission reduction, clean technology advancement, and sustainable development. The plan is steered by eight strategic directions and principles, according to the Government of Alberta (2023), with an emphasis on collaboration, clean technology, innovation, and the development of financial and policy frameworks. By 2050, Alberta wants to have a carbon-neutral economy while maintaining reliable and affordable energy. To increase the province's efforts to reduce emissions, the strategy makes use of the resources, connections, and infrastructure already in place. Alberta wants to attract investment, therefore it has established a reliable regulatory framework. The strategy also values Indigenous Peoples' leadership in the development of natural resources and energy as a component of the larger process of reconciliation (Government of Alberta, 2023).

4.1 Alberta Health Services (AHS) Sustainability Journey

Alberta Health Services is an active participating member of the Green Hospital Scorecard (GHS). The GHS is coordinated by the Canadian Coalition for Green Health Care with the goal of improving the environmental impact of Canadian healthcare. The GHS programme offers pertinent metrics for hospital administration, operations, and the execution of environmental and energy-related policies. The AHS Environmental Sustainability Policy (2020), describes the applicability of the document to all AHS stakeholders, including staff members, medical professionals, students, volunteers, and service providers under contract. The text focuses on three key areas: monitoring GHG emissions from diverse sources, putting creative solutions into practise to cut emissions and water use, and encouraging sustainable behaviours like reducing travel and boosting alternative transportation. AHS must also inform stakeholders of the necessity of lowering GHG emissions and develop an action plan with goals for doing so in their operational facilities.

The policy document outlines additional sustainability initiatives for AHS to include implementing waste reduction methods into practise, commencement of recycling programmes, encouraging eco-friendly shopping habits, pushing for LEED certification in building projects, and ethically sourcing food. These programmes demonstrate AHS's commitment to waste reduction, recycling promotion, taking environmental impact into account while making purchases, using sustainable building techniques, and offering sustainable food services. In summary, the document indicates AHS's dedication to environmental sustainability and meeting GHG reduction targets.

The GHS is a tool used for measurement and verification, analysing several areas of a hospital's environmental and sustainability activities (Canadian Coalition for Green Health Care, 2012). Energy conservation, water conservation, waste management, pollution avoidance, and business leadership, planning, and management are all examples of these elements. Participating hospitals fill out a survey about their environmental initiatives, and depending on their results, they receive a scorecard that classifies them in comparison to their peers. This programme assists hospitals and their executives in improving existing benchmarking data, refining data collection procedures, and producing useful reporting information. It raises awareness, motivates behavioural changes for future conservation efforts, and encourages environmental stewardship by recognising hospitals' accomplishments. Furthermore, the GHS provides an in-depth assessment of the organization's environmental performance by utilising confidential peer data. It makes it easier to identify areas where adjustments can be made to increase environmental performance and operational efficiency.

The GHS also serves as a benchmarking tool, allowing hospitals to compare their efficiencies with those of other hospitals in the industry. Through annual levels achievements, organizational recognition is provided to inspire organisations in the sector to strive for excellence in environmental performance. Outstanding performers are also recognised with yearly Green Health Awards, which encourage and promote excellence in environmental stewardship.

Rockyview General Hospital (RGH) is the first and the only listed AHS institution on the Green Hospital Scorecard (GHS). RGH educates and encourages frontline healthcare personnel to reduce our environmental impact and carbon footprint, as well as to strengthen overall environmental sustainability, through its Green n' Health project. This project focuses on several critical areas, including optimising the recycling programme, lowering and eliminating waste, energy, and water use, and moving the culture of the organisation towards environmental sustainability.

According to Harris (2019), who reviewed a recent study that was published in the journal Healthcare Quarterly, AHS has one of the top health supply chain management methods in the world. The study finds that by leveraging supply chain systems that purchase and track products till they reach the point of patient care, AHS is reducing costs and enhancing patient safety. The authors write in their case study that, "AHS approaches ….. is well positioned to become the first health system globally with a clinically integrated supply chain infrastructure that will be able to track and trace the care processes and the products used in care that achieve the best outcomes for specific population segments and identify the conditions under which best outcomes can be achieved for all Albertans".

Alberta Health Services' Full Year 2022 Inventory (Apr 01, 2021 to Mar 31, 2022) Carbon Footprint details the GHG emissions footprint for GHG Protocol Corporate Accounting and Reporting Standard. Compared to their 2018 baseline of 1,022,814.25 tCO2e, AHS has reduced their emissions by 866,726 tonnes of tCO2e amounting to a reduction of 15% (156,088 tCO2e) (AHS, 2023). See AHS GHG Emissions Report and boundary in appendix C and D.

4.2 Benchmarking the Sector

The main goal of comparing health sector organizations is to establish industry standards for reporting logistics and sustainability. These standards may then be applied to AHS to determine where it stands when compared to peers on sustainability metrics. Sectors are continually seeking to optimize their logistics network to reduce costs and improve overall efficiency, and AHS is no

different. It can be burdensome trying to understand the logistics of the health sector, especially for laborious and time-consuming tasks like systematizing shipments. Industry leaders and peer companies who have their own fleets are more consistently reporting emissions as they readily have access to this data. Additionally, leaders within the industry are beginning to report on their suppliers' emissions. For example, the NHS in England has been attempting to quantify and reduce its carbon footprint since 2008 (Tennison et al, 2021). The carbon footprint of the NHS in England in 2019 was 260 MtCO2e, with 62% of that footprint originating from its supplier network (including emissions from imported goods and services) and only 24% from the delivery of care scope, emphasising the significance of an integrated global effort to achieve an efficient decarbonisation of health care (Tennison et al, 2021). The NHS employs three specific strategies to reduce emissions from its supply chain. These strategies include: improved use of supplies by eliminating single-use tools and relying more on refurbished and reusable resources; low-carbon substitutes and product innovation by exploring and encouraging innovative methods that can improve patient outcomes while having a lower environmental impact; and ensuring the decarbonization of supply chain procedures with the intention of achieving large carbon emission reductions through carbon transparency reporting (NHS, 2023). The NHS wants to make sure that its suppliers decarbonize their own operations while conveying immediate and lasting signals about the most effective strategy of action. This approach began with the NHS supplier engagement plan, which aims to reduce carbon emissions significantly through carbon transparency reporting (Tennison et al, 2021). In an early trial NHS supplier engagement programme, 27 suppliers freely shared their carbon-reduction plans. According to the report, engagement will be increased to 500 major NHS vendors by 2021. A contract will be created with clinical consumables and medical equipment suppliers to reduce emissions from product packaging. This process will acknowledge and support the requirements of small and medium-sized businesses, as well as the NHS's position as an anchor institution in England.

The NHS in the UK is a pioneer in tracking its own carbon footprint. It is mandated to achieve net-zero emissions by 2045. Around 50 countries, including the US, with its newly established Department of Health and Human Services (HHS) Office of Climate Change and Health Equity, pledged to achieve environmentally sustainable health systems by 2020, building on their ground-breaking "Delivering a Net Zero Health Service" strategy. This promise was made through a World

Health Organisation initiative during the COP26 summit in November 2021 (HHS, 2021). While this is encouraging, relying exclusively on volunteer commitments and actions will not be enough to meet the net-zero healthcare goals. Furthermore, in 2022, funding and authority for implementation were incorporated into UK legislation. The US, on the other hand, lacks such legislatively mandated targets or committed resources for this purpose. However, just like the NHS three strategies to reduce emissions, the HHS has proposed three strategies for emissions reporting and measuring: mandating the use of a common set of measurements across health care in the US; providing organisational governance and infrastructure for measurement and action; and promoting measurement, benchmarking, and openness through legislative innovations (Singh et al, 2022). There are organisations within the health sector that are just starting to measure and report their Scope 1 and 2 emissions and may recognise the need to look into their supply chain but don't yet have the capacity or methodology to do so. This includes AHS, which reports Scope 1 and 2 emissions on an annual basis and is aware of possible concerns in the supply chain, notably transportation, but has yet to interact with suppliers to build a Scope 3 carbon inventory. AHS works with third-party logistics companies on a regular basis to carry materials to distribution warehouses.

4.3 Interviews with Industry Experts

This section focuses on the analysis of the interviews with industry experts. Interviews were conducted virtually with five (5) experts in the healthcare industry to better understand the barriers and facilitators to quantifying and disclosing emissions and to investigate the internal perspective of this reporting within the corporate framework. See Appendix E for interview questions.

4.3.1 Participants

Table 1. Interviewees' Demographic Table

Participants	**Gender**	**Years in Current Position**	**Type of Organization**	**Position**
IV1	Male	5 years	Health Services	Services Office of Sustainability and Energy Management
IV2	Female	8 years	Academic Clinic	Clinic Administrative Assistant and Procurement personnel
IV3	Female	9 years	Community Clinic	Nursing Clinical Lead and Inventory Manager
IV4	Male	1 year	Health Services	Executive Director for IT, clinical support services and capital equipment
IV5	Male	4 years	Logistics	Chief Financial Officer

A total of 5 industry personnel (two women and three men) from a range of disciplines and with varying levels and years of experience participated. These experts included representatives from AHS departments, clinical procurement staff, and a supply chain company. Their age, ethnic backgrounds and cultures of origin were not taken into consideration. For purposes of anonymity, we will refer to the interviewees as IV1, IV2, IV3, IV4 and IV5.

4.3.2 Thematic Analysis

4.3.2.1 Lack of Knowledge

Though a good number of the interviewees have outstanding knowledge of emission reporting standards and measuring, knowledge gap is a notable theme that is observed across some of the transcripts. Here is analysis of how this theme emerges from the conversations:

Scope Emission Understanding: In several instances, interviewees highlight the challenges associated with understanding and effectively addressing all three scopes of GHG emissions. They mention that Scope 1 and Scope 2 emissions are relatively more manageable and understood, but there is a lack of clarity and knowledge when it comes to Scope 3 emissions, particularly those associated with the supply chain.

"…. I am not sure whether we report that…" (IV4)

Scope 3 Complexity: Interviewees expressed uncertainty about how to accurately track, measure, and reduce Scope 3 emissions due to the complexities of indirect emissions sources. This lack of knowledge stems from the diverse range of activities within the supply chain and the difficulty of obtaining reliable data from suppliers.

"….. It is very complicated for companies to first of all understand what it is that they're supposed to report……." (IV5).

Some of the interviewees also acknowledge not being familiar with specific reporting standards related to Scope 3 emissions, as well as knowledge on set targets on emission reduction within the sector indicating a potential gap in understanding in this area.

" …I don't know if we necessarily have goals or targets……I don't know what that goal number is, but I think we could easily reduce waste for sure…" (IV2)

This knowledge gap can also be attributed to interviewees' position and the departments in which they operate within AHS – a senior management vs. procurement personnel at clinical level may well have different amounts of training and familiarity with the need and process to track carbon emissions.

4.2.3.2 Autonomy/Agency

Several interviewees stated that AHS policies have an impact on the emissions produced by the clinics. They make known that there exist challenges of decreasing emissions while working within the limitations set by AHS policies. For example, an interviewee deduced that the AHS policy on single-use items, while intended to prevent and control potential disease spread, are also

responsible for possible overuse of single-use equipment and thus contributing to increased supply chain footprint.

"…… I personally feel like we're probably a little stuck because we're with AHS… AHS has… kind of strict guidelines regarding infection prevention and control…" (IV2)

Conversely, there was also mention that lack of a defined strategy or objectives provides no agency for recording and reporting Scope 3 emissions. Currently, AHS is just collecting data on Scope 1 and 2 emissions because they are short on the resources and backing to take further action in this respect.

"…. If you have a policy, you need to have a plan and you need to have a commitment from management to do that. So, we don't have yet any clearance instructions to reduce Scope 3 emissions…" (IV1)

Finally, there is also the barrier of policy enforcement. If it is not mandated by policy or law, it likely will not happen voluntarily. AHS sustainability does not yet have the process or power to have suppliers comply with emission targets.

"….. I don't think we have the necessary tools or levers to meaningfully influence companies to reduce emissions in their supply chain…." (IV4)

4.2.3.3 Barriers to Reporting

The Interviewees stressed on some of the challenges of reporting Scope 3 emission to include lack of the qualified sustainability professionals, appropriate tools, resources, and defined methods for gathering and reporting emissions data. These make it difficult to track and report emissions accurately in the AHS. Additionally, another obstacle to reporting arises from the current situation where the AHS is primarily concentrating on direct emissions.

"…. For AHS, our focus is in direct emissions…" (IV1)

4.2.3.4 Cost as a barrier

Interviewees underscore the challenge of striking a balance between sustainability goals and financial objectives. Cost, competing priorities, and limited bandwidth takes priorities ahead of GHG reduction:

"…. As far as you know, the barriers of cost are always going to be a reality…" (IV3)

"….we still need to find that balance of getting the right product at the right cost for the healthcare system because we don't have unlimited money. And we want to make sure that the product is going to give us good clinical outcomes for patients…" (IV4)

The main emphasis of AHS at present is directed towards minimizing energy expenses rather than primarily targeting a decrease in carbon emissions.

"…. The budget that we have is not for carbon emission reduction, it is for energy cost reduction…" (IV1)

Another area of interest in the interview was when asked about the efficacy of supply chain collaboration as a means to reduce Scope 3 emissions, one participant stated that incentivizing the supply chain through contractual arrangements could provide favourable results:

"...Yes. We can collaborate to decarbonize logistics, which will take some time, but I think we can incentivize through our RFP's and signaling to a degree that sustainability is important aspects of our proposals…" (IV4)

The tracking methodology planned by AHS to track its Scope 3 emissions is the top-down, using expenditure on purchased goods/services for supply chain (IV1). Following the identification of these key areas of areas of high emissions or the high intensity of emissions, the plan would involve engaging suppliers and requesting that their emissions reduction plans line with the organization's emission reduction targets (IV1).

Technological maturity was also mentioned as a current barrier to Scope 3 emissions reduction in healthcare logistics companies. It will take an EV truck 10 times the amount of time it will take a

Diesel truck to travel about 7000 kilometers across provinces (IV5). According to IV5, this poses a risk considering that they also run a temperature-controlled network:

"…. lots of opportunities to improve emissions over time, but I think there's still a lot of technology and a lot of R&D that still needs to be done to make these things commercially effective..." (IV5)

Chapter 5 : Discussion

5.1 Linking ESG with the healthcare mission

Healthcare leaders have a common goal of improving the health and well-being of individuals and communities. Adopting ESG practises supports this aim and can spur innovation, boost our worth, and progress our companies' operations. Various stakeholders, including employees, suppliers, agencies, and financiers, can rely on the ESG framework to guide their decision-making. Nevertheless, the healthcare sector is well-positioned to address the interconnected nature of ESG concerns. Promotion of global health equity demands a thorough understanding of environmental challenges. Climate change, extreme weather events, air pollution, water scarcity, and soil degradation all pose risks to community health and economic well-being in the short and long term.

According to World Health Organization (n.d.), for instance, air pollution is a primary cause of early death and costs the world economy $225 billion yearly. However, these threats affect different communities unevenly due to social determinants of health, making certain segments of the population more vulnerable. Vizient's (2022), Vulnerability Index highlights the link between specific social determinants, such as the environment, and health outcomes. To achieve shared mission, there is need for collaborate to restore ecosystems and make health equity the new standard. In order to create workable frameworks for addressing climate change, the healthcare sector is partnering with other industries. Although organizations must take individual responsibility for their strategies, working together is vital to make a significant impact in healthcare. Making ESG a shared priority requires establishing community connections and giving sustainable supply chains top priority. Shifting approach from efficiency to resiliency and incorporating these principles into mission, strategy, and organizational culture are crucial steps as global future depends on it.

5.2 Incorporating ESG into Green Supply Chain

This simply means the ability to take an environmental approach to supply chain. The demand for health systems to comprehend and adhere to ESG principles is tied to the transformation taking place within the supply chain. The public communities, patients, staff members, and even the government at large have increased their expectations for healthcare organisations to adopt and

engage in socially responsible concepts and values since the COVID-19 pandemic. Healthcare's supply chain and the choices made by healthcare professionals have a significant impact on the environmental and social pillars of ESG. Healthcare's supply chain and the choices made by healthcare professionals have a significant impact on the environmental and social pillars of ESG (Zuckerman, n.d.). It is a crucial component of supply chain management given that it helps to minimise carbon emissions while also promoting social development (Zeng et al, 2022).

In light of the negative consequences of global warming, such as increased flooding and drought, numerous sectors and countries are taking steps to mitigate carbon emissions. Green supply chain management also highlights the importance of implementing environmentally friendly practises. This section focuses on the necessity of including ESG factors into assessments of the effectiveness of green supply chains. The goal is to figure out how ESG factors affect the efficiency of a green supply chain.

Green supply chain management is a contemporary management approach that integrates environmental considerations and resource efficiency into category management (Chen et al, 2009). It acknowledges how supply chain operations have an influence on the environment. Environmental management is prioritised in green supply chain management through products choices, production techniques, and upstream and downstream suppliers (Rabbi et al., 2020). Overall, implementing a green supply chain can contribute to carbon emission reduction.

According to Bowen et al. (2001), "green supply chain management" refers to cooperative efforts by businesses, suppliers, and consumers to lessen the environmental impact of manufacturing processes and goods. Green supply chain management incorporates environmental factors into supply chain management by focusing on products, production methods, and supplier selection while considering both costs and benefits for all stakeholders (Li and Zhou, 2022). This approach helps companies mitigate the negative environmental effects of logistics activities, supporting sustainable development and growth. The selection of green partners becomes crucial as environmental concerns, like carbon emissions gain attention. Traditional supplier selection processes often overlook environmental aspects, necessitating the strengthening of green supply management to minimize environmental impact. Green supply chain management offers an opportunity for organizations and sectors to cut carbon emissions through innovation, in line with consumers' growing environmental awareness. Including environmental and financial data has

been indicated to be important in supply chain emissions evaluation as a way to improve performance rating.

To enhance performance evaluation, environmental and financial data should be incorporated into supply chain assessment. Enhancing decision-making and fostering sustainable competitive advantage are two benefits of tracking and analysing a green supply chain's performance. Evaluations should encompass environmental, operational, and economic dimensions, addressing negative impacts and resource waste throughout the supply chain process. To guarantee a thorough performance assessment, all stakeholders should be included in the evaluation process. Growth of ESG practices and increased focus on ESG considerations can be accomplished through green supply chain management. According to Fernando et al. (2019), offshore green supply chain management indirectly improves economic, environmental, operational, and social performance.

5.3 Health Sector and Supply Chain Collaborations

Expanding the ESG strategy of the healthcare sector to include collaborations with the supply chain can significantly help lower their overall environmental impact and mitigate climate change risks. This starts by first assessing the current impact by conducting a comprehensive assessment of the healthcare industry's current environmental impact, including Scope 3 to identify the key areas where collaboration with the supply chain can make the most significant difference. The establishment of transparency is therefore required by creating a baseline for supply chain emissions and communicating with suppliers. One of the biggest challenges to regulating emissions from medical equipment and supplies is limited data transparency and traceability within the supply chain. Healthcare organisations can use their purchasing power to influence the market and create a supply chain ecosystem that is more open and low-carbon. The NHS's Science-Based Target Initiative adopted to increase data transparency and traceability, provides impartial, standardised guidelines on measuring and reporting carbon reductions, with targets and timetables based on climate science (AHRQ, 2022). This transparency enables better tracking of Scope 3 emissions and identification of opportunities for improvement.

Suppliers and Stakeholders Engagement is usually an important step for an organization desiring to measure their Scope 3 emissions due to logistic activities. Fostering communication and collaboration by developing a platform for open debate and participation can increase transparency

by establishing a baseline for supply chain emissions and exchanging data with suppliers. This transparency allows for more accurate tracking of Scope 3 emissions and the identification of areas for improvement. To effectively collaborate with suppliers, stakeholders, and appropriate industry organisations, it is imperative to build a platform for open communication and interaction. Developing a Scope 3 inventory specific to a particular entity encourages quantification and reporting of emissions from individual partners across the value chain. One of the key objectives for most organizations that are committed to energy transition, is to motivate their suppliers to measure and report GHG emissions so as to set reduction targets and eventually ensure that those targets met. As mentioned earlier, some of the demand for emission disclosure and reduction originate not only from within the organizations, but also from external stakeholders. This can be achieved by hosting workshops, conferences, or roundtable discussions to raise awareness about environmental issues, climate change risks, and the importance of ESG practices. The ability to demonstrate good standing in measuring and reporting, with increased environmental awareness, also makes a company more appealing to stakeholders and customers.

A clear overall ESG strategy for healthcare organisations can be established with the support of quantifiable sustainability goals and targets. These objectives could be centred on areas like waste management sustainability, energy efficiency, and procurement. Improvements to the ESG strategy can be made by incorporating the organization's ESG criteria into the procurement system via supplier agreements. This includes establishing criteria for environmental effect, social accountability, and governance measures. As well, the incorporation of supplier scorecards or assessments should be considered in order to systematically track and evaluate their ESG performance.

By rewarding innovation and teamwork, suppliers can be pushed to adopt eco-friendly practises and technologies. This might entail providing financial or technical assistance or rewarding suppliers for reaching sustainability milestones. Partnerships and collaborative projects can increase the impact of environmental initiatives. This can be accomplished through cooperating with other organisations and industry peers to share expertise, perspectives, and best practises for sustainable supply chain management. Another approach can involve creating a sustainable sourcing strategy and encourage redesigning products for sustainability.

Healthcare organisations have no direct control over emissions entrenched in the supply chain, but, these organisations, on the other hand, can use their significant purchasing power to persuade

suppliers to improve the environmental sustainability and carbon intensity of their products through cleaner energy usage and more efficient design for reuse, repair, remanufacturing, and material recovery. The use of single-use disposable medical supplies and gadgets not only exposes health systems to supply chain interruptions, but they are also widely mentioned as having greater life cycle emissions per use when compared to equal applications of reusable alternatives. To reduce carbon emission intensity, the sector needs to adopt and expand circular economy policies and practices related to reuse, reprocessing, repair, repurposing, and recycling; as well as adopt preferential purchasing with suppliers or service providers that perform carbon disclosures and have set a science-based target for decarbonization. This can be accomplished by incorporating purchasing criteria into RFPs that indicate a preference for suppliers with transparent, standardised GHG inventory and a science-based emissions/net-zero targets.

Chapter 6 : Conclusions & Future Research

6.1 Conclusion

When reporting emissions, emphasis is placed primarily on quantifying and recording emissions from Scope 1 and Scope 2. However, in many cases, the emissions generated throughout the supply chain, also known as Scope 3 emissions, constitute a larger portion than their Scope 1 and 2 emissions. Despite the recognized need to include Scope 3 emissions in emissions reporting, there are inherent challenges in doing so. The time, both technical and operative resources required to quantify these emissions, lack of standardised methodology for measuring and reporting, as well as the over reliance on third-party vendors to get the required information are among the barriers. Furthermore, different industries produce emissions in different ways, making it difficult to compare data on a larger scale. Whilst having complete control over their entire supply chain would be desirable, it is impracticable. To organize efforts with suppliers, organisations must rely on engagement and CSR strategies. In order to reduce supply chain emissions based on ESG principles, this project examined how the health sector can collaborate with its supply chain. The case study of AHS, although still in the early stages of measuring, reporting, and reducing emissions from its supply chain, highlights the importance of identifying high-emission areas by analyzing expenditure and working with suppliers to reduce their emissions and align with AHS's emission reduction targets in the future. Having a comprehensive understanding of the supply chain allows for better identification of risks and opportunities to mitigate them.

The study also considers platforms and methodology for measuring and reporting Scope 3 emissions. Each platform requires organizations to complete a simplified questionnaire. However, organisations frequently must provide responses to several questionnaires because there aren't any standardised methods and a variety of platforms available. Given the limited time and resources available, this inefficiency can lead to insignificant information that can reduce the quality of disclosure. ESG serves as the fundamental framework for achieving sustainable development and encompasses the environmental, social, and governance aspects of enterprise practices and performance. Given the large carbon footprint of the healthcare supply chain (from 60 to 75% of healthcare delivery emissions), strengthening ESG management and promoting green development in the supply chain are essential for reducing carbon emissions. This approach

represents an inevitable trend in developing environmentally conscious supply chains for enterprises in the future.

We have also discussed how sustainability reporting builds upon the successes and experience of measuring performance and quality in healthcare. Reporting in healthcare systems serves two main purposes: accountability and improvement. Lastly, it is not sufficient for organizations to merely engage, measure, and take actions to reduce emissions. They must also publicly report these initiatives and control the narrative. With a growing environmentally conscious public, investors, and other stakeholders, there is increasing demand for proactive efforts by corporations to address climate-related risks. Various communication channels exist for organizations to share their environmental performance, depending on their target audience.

6.2 Limitation

This study had limited representation across the sector, in that the sampling should have extended to a broader mix of small and large clinics, persons on different authority levels within the AHS, distributors, pharmaceutical companies, among others. One of the challenges of obtaining representative sampling across the healthcare system is its inherent size and complexity, which is why we targeted key informant interviews, but we could have only included additional interviews with more time in the course.

6.3 Future Research

When it comes to a company's carbon footprint, Scope 3 emissions often make up the largest share, especially for businesses with intricate supply chains like the healthcare system. Due to this complexity of this Scope, carrying out a lifecycle study of the products purchased and used within the supply chain could offer better insights into the carbon footprint, resource consumption, pollution, and produced waste associated with products. The knowledge of the carbon/environmental footprint of the various elements in Scope 3 emissions can make for strong reduction efforts towards targeted emissions.

Despite the on-going success being seen in supply chain management strategy, there is still much to learn about how to effectively apply this corpus of knowledge in the healthcare sector. Only a small number of studies had previously addressed green supply chain management strategies, and

those studies had mainly concentrated on manufacturing-specific green strategies in other industries. When it comes to implementing a green supply chain management strategy, healthcare gets relatively little attention. By developing a theoretical framework for the factors impacting green supply chain management strategies in healthcare businesses, this study's novel initiative can reduce the gap.

The interaction between environmental performance, social responsibility, and governance can also be studied further, and a model based on ESG can be developed to assess the performance of the green supply chain. Managers' decision-making can be empowered and enhanced as a result, and we can provide a stronger roadmap to decarbonizing the delivery of healthcare.

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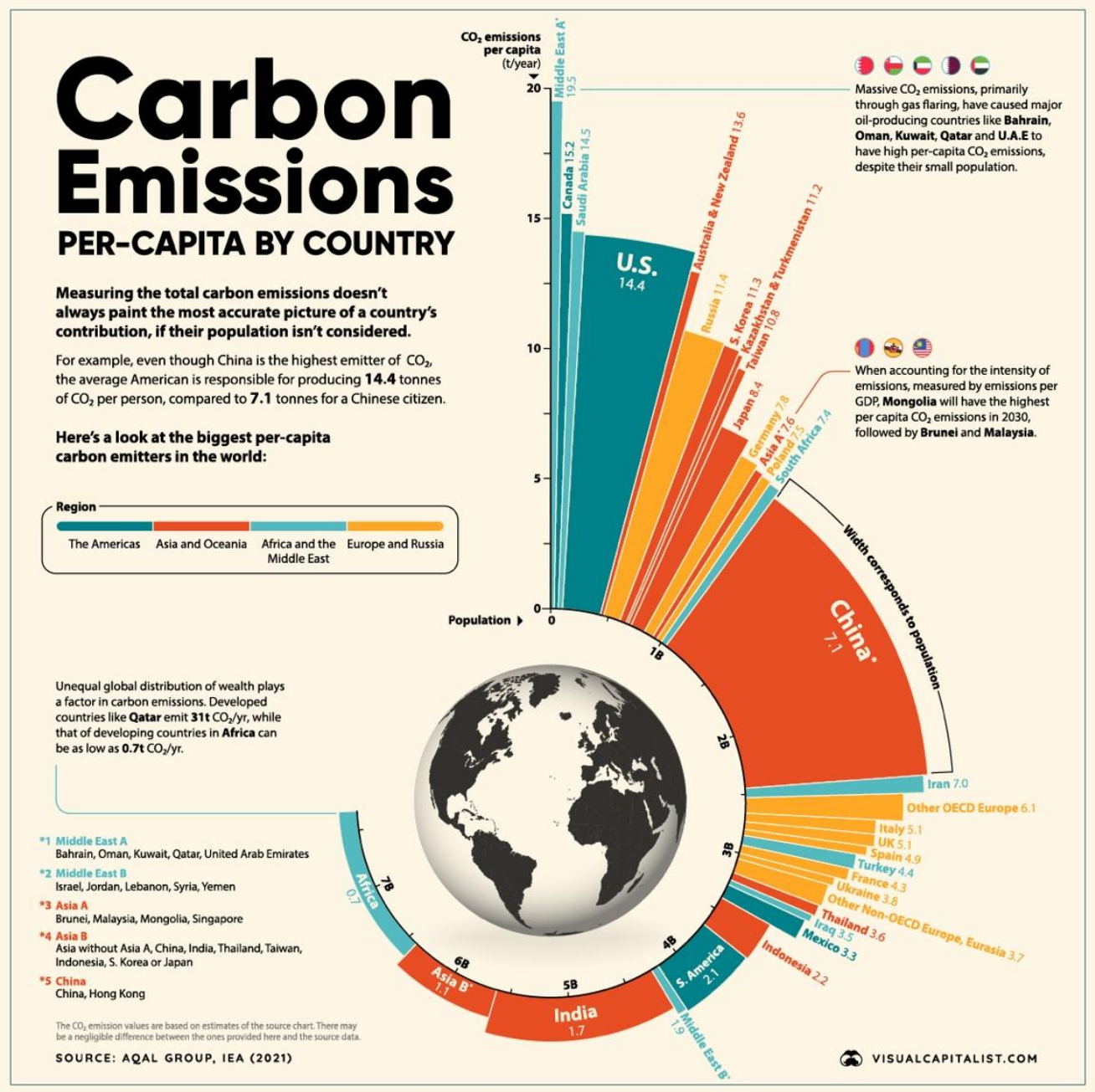
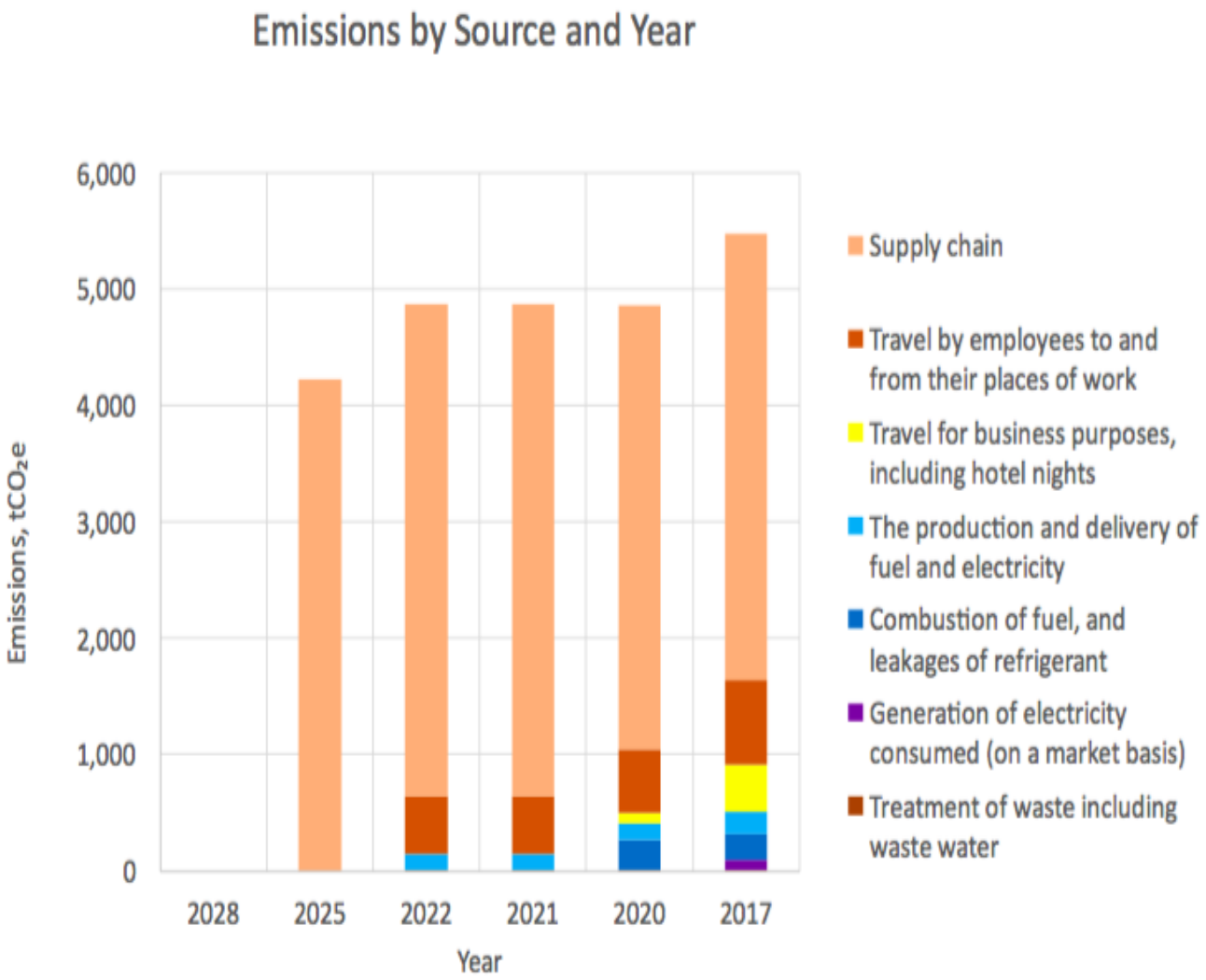
Appendix A: Global Per Capita CO2 Emissions



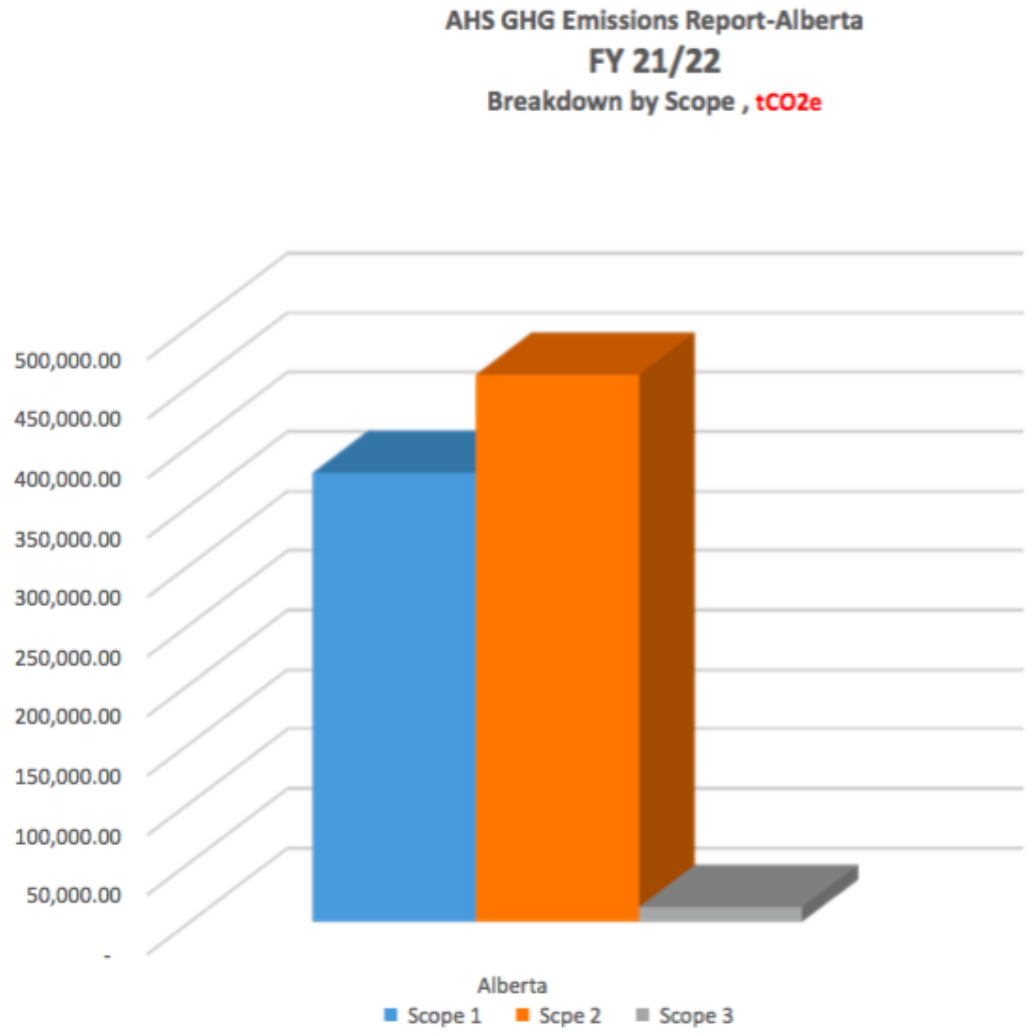
Note: Deshmukh, 2021

Appendix B: NHS Emissions Reductions Past and Projected



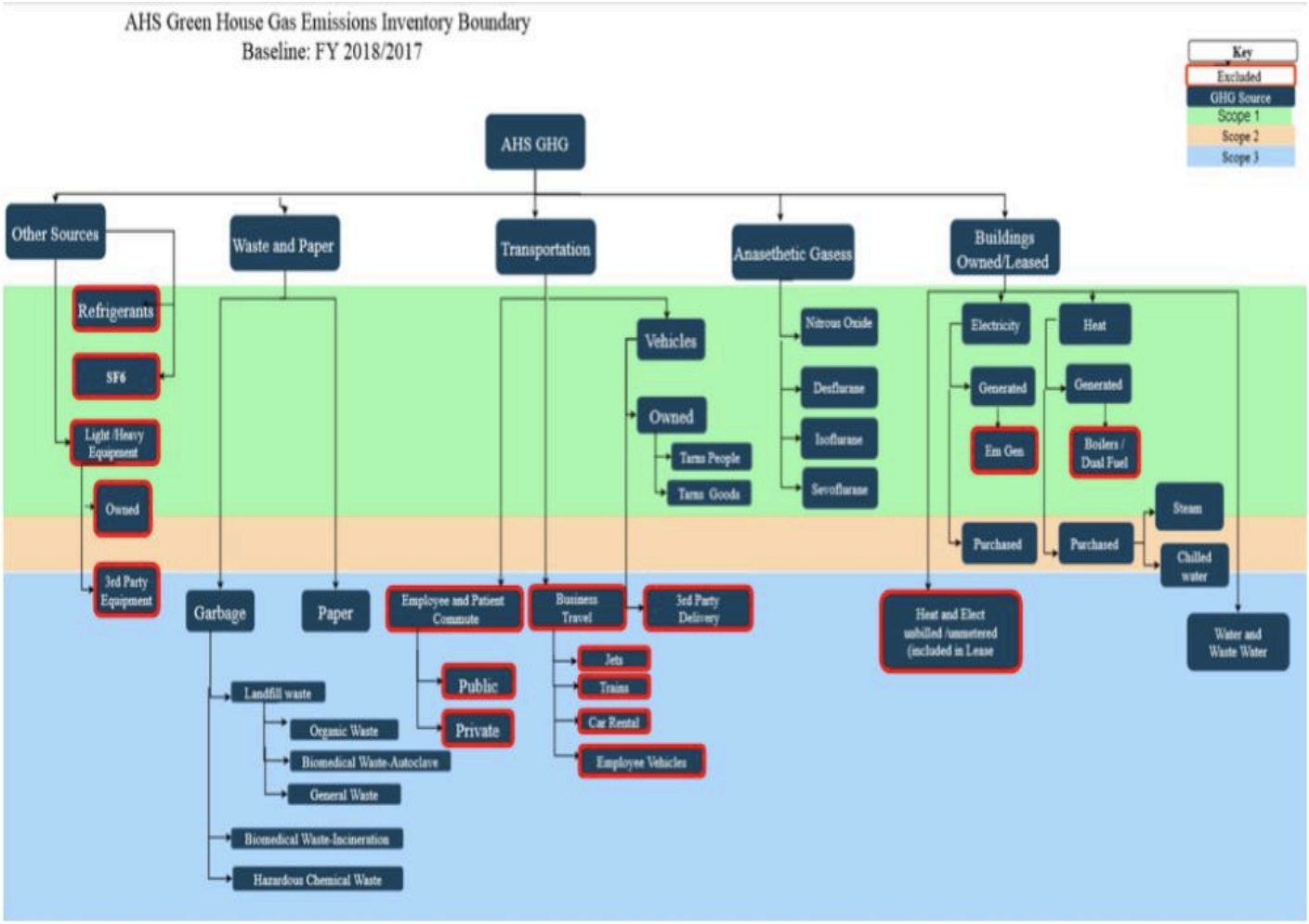
Note: NHS, 2022

Appendix C: AHS GHG Emissions Report- Alberta FY1/FY2



Note: Alberta Health Services, 2023

Appendix D: AHS GHG Emissions Inventory Boundary



Note: Alberta Health Services, 2023

Appendix E: Interview Questions

1. Do you have knowledge of any common standard being used for Scope 3 (indirect supply chain/disposal) emissions reporting in healthcare companies/organizations?
2. What do you think are some factors that influence direct and indirect emissions reporting in the healthcare sector?
3. Are there existing procedures in place to set emission reduction goals and targets in the interviewee Organization/Healthcare Sector?
4. Are there programmes (government or otherwise) or partnerships being promoted to help the Healthcare sector gain a better understanding of their Scope 1,2,3 emissions?
5. What are some barriers to GHG emission control in healthcare supply chain? Probe: Why do you think these barriers exist?
6. What could be done differently to overcome the barriers to reducing supply chain emissions?